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THE ARNESON TECHNIC FOR THE CORRECTION OF SQUINT*

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The correction of Squint, by either operative or non-operative methods, or by operation followed by training exercises, is a problem that has challenged and baffled the ingenuity of refractionists since the earliests days of the study of visual defects and binocular dysfunctions. During these years many theories, mostly speculative, have arisen, run their course, been found inadequate. Some have been shown to be partially true, in that they applied to a few cases but not to all. Though their proponents, having experienced success in a few cases, seemed to feel that their theories ought to be accepted as applicable to all Squint. Other theories have been found pitiably weak, based on entirely false premises. Such have been presented by men with little practical experience outside the operative field, workers who have shown little initiative in the development of non-operative measures. Of these latter, perhaps the one with least merit is the "fusion theory," which postulates that squint occurs because the individual "congenitally lacks the fusion sense." Since fusion, like all the binocular functions, is never innate, is in all persons "congenitally lacking," but is acquired experimentally, this theory starts from a false premise. It is surprising that it was ever presented. It is an illustration of the type of unsound reasoning that has given us so many misleading theories whose adoption has proved so great a stumbling block in our progress toward the solution of the questions of binocular functions, balances and imbalances.

The finding that some convergent squints were remedied by the wearing of strong plus lenses brought into existence the theory that convergent squints are the outcome of the strain induced in the compensation of structural hyperopia. This is, without doubt, true in the minority of cases but has proved untrue in the majority. It has become the custom to crowd on plus lenses in all cases of convergent squint, in the hope that this hit or miss method might happen to apply to the case in hand. Just how it happens that few have

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given serious thought to their many failures in straightening strabismus by strong plus lenses is a conundrum.

The fact that latent hyperopia may produce a divergent squint as well as a convergent squint does not seem to have been appreciated to any extent. I have seen no references to this in our literature. But such an occurrence is possible under the laws of the physiological action of muscle, just as convergent squint with latent hyperopia is explainable under those same laws. There are several definite types of squint and it would seem the part of wisdom to direct our studies toward their analysis and classification from the cause standpoint rather than from the end organ result grouping now in use. This latter is very well from the viewpoint of those who rely on operative methods but is utterly useless for the use of those who are seeking successful non-operative methods.

I have found that the use of plus lenses is an actual drawback, a block in the way of success, in certain types of convergent squint. And that in these types, when plus lenses have been worn for a number of years, no progress forward is possible until the lenses are removed. Moreover, the wearing of such lenses over a period of years prevents the development of the normal visual reflex arcs of allied convergence, accommodation and pupillary contraction.

As to the so-called "fusional training" exercises on which we have put so much dependence in the past, there are many cases in which these are of no great benefit, some cases where such exercises prove a hindrance and have to be discarded in favor of other methods. In those cases where the use of such exercises has been followed by success, I am beginning to feel that while we thought we were "educating the fusion faculty," in fact we were doing the same thing that helped us in other cases, to-wit: developing the habit of attention in the cortical receptors of the squinting eye, breaking down the tetanus in the contracting muscles, stimulating the hypotonic antagonists, establishing motility and balanced reciprocal innervations—in short, establishing monocular functioning for the eye whose use had been long discontinued. For it is becoming very evident, as our work proceeds and we attain a higher percentage of success in the non-operative treatment of squint, that monocular efficiency must precede binocular functioning; that when the former is established the latter takes care of itself to high degree. We find some cases where the assumption of binocular functions is almost immediate when the tetanized muscle is inhibited. While in other cases, a certain amount of training in binocular functions is needed. But it is clear that monocular training must precede the binocular education.

In this we seem to be but following nature's order. In the infant, monocular control, monocular fixation, precedes the binocular attempts. Always the simpler must be conquered, the elemental must be the foundation, single muscle control does and must precede associative controls. In all our work, our degree of success is meas-

ured by our ability to conform with fundamental physiological and psychological principles. The instant we depart from these and attempt to foist on nature some artificial ingenuity that is based on unsound speculation, we are booked for failure.

It would be folly to presume that we are in possession of many fundamentals of physiological psychology. But the workers of the past two or three decades have succeeded in wresting from nature enough of her secrets to inform us that most of the earlier theories concerning the binocular functions are false, merely unwarranted asumptions founded on observations of end organ results mixed with highly imaginative speculations.

In our little band of a half dozen co-workers, since we have abandoned the "fusion theory" and the systems of exercises based thereon, our precentage of success in correcting squint has been 100% with the exception of the problem of alternating squint. There we have been baffled, being able to succeed in only about a third of the cases undertaken. Yet in those, success followed the application of the same laws we had followed in the treatment of other types, but we were handicapped by the lack of equipment and insufficient development of technic. Moreover, none of us seemed to have sufficient ingenuity to be able to produce the lacking detail. And in the other types of squint, convergent and divergent monolateral, we were fully aware that our equipment and methods were but half developed, that there was a gap, that we were still groping and spending more time with most of the cases than would be necessary if something could be found to fill that gap. The search for this missing bit of technic and the essential apparatus has occupied us for several years.

Merely because of an unwillingness to leave any lane unexplored, whether or not it gave promise of holding matter of additional value, the writer investigated the Arneson apparatus and methods, it must be confessed with no great expectations of finding much either new or useful. Though rumors had reached us that the Arneson technic was proving remarkably successful, there are so many such rumors, our ardent hopes have been so often blighted, that it seemed probable that another theorist with ambitious claims because of a little success had arisen. So it was only as a matter of compulsory routine that the investigation was undertaken.

It was, then. with no little surprise that I found, not only that Arneson was employing the same principles that we had learned are fundamentally correct, but he had succeeded in producing the lacking pieces of apparatus and in developing a technic of maximum efficiency with the minimum of time and effort. It is apparent that the combination of methods developed by McCulloch, Mrs. Martin, Robertson and Peckham with those of Arneson will carry us far toward the mastery of squint problems.

The Arneson apparatus and technic were substantially com-

pleted, essentially in their present form, by 1924. But, as it is, of course, to a large degree, a negation of and contrary to, many of the ideas held in the past, there has naturally been considerable doubt in the minds of those to whom it has been demonstrated as to its value. There has, therefore, been little encouragement for attempts at publicity.

But since it has been in successful use for several years; since there have been an astonishingly large number of squint cases corrected and most of these individuals are accessible for corroboration; since the principles involved are those that we have found true and workable; it is now time to bring the matter before the profession and place the apparatus in the eager hands of those who have been anxiously awaiting just such an invention.

The apparatus consists of a revolving disk, motor driven, with adjustments for variation of speed and reversible direction of rotation. Attached to one side of the disk is a target. The center of this target is red glass cut in facets reflecting light, which has proved far more efficient in attracting attention and stimulating vision than the moving lights with which we have all been experimenting through many disappointing years. Surrounding this target are two raised concentric circles, colored either red or mottled red and white. The feature of these outer circles is that they are in relief. By experiment, Arneson has found that flat rotating objects, or flat circles painted around his central facetted button, are less stimulative than these circles mounted to give relief effect. Probably our failures to accomplish much with the rotating lights and projected images we have been experimenting with, has been due to our not thinking of trying targets built in relief. The disk is illuminated by reflected light supplied from a lamp with reflector suspended above and to one side of the patient's head. The relief targets, then, as they rotate, are subject to a continuous alteration of light and shadow, the facetted surface of the red central button catches and reflects the rays from the lamp in a continuously changing series of flashes.

The surface of the disk is dull white, on which is painted a huge E in black, with a red and blue border. The revolution of vertical and horizontal bars of this E gives an odd spiral effect, intensely intriguing to the observer, attracting a binocular attention that is seemingly a considerable factor in causing the visual axes to draw to the position of single binocular vision.

The target with facetted button and the surrounding circles is so attached that it can be moved toward or away from the edge of the disk, thus making it possible to use a larger or smaller rotating circle, as the operator may wish. In general, it seems advisable to commence the exercises with the target set to revolve in a small circle at slow speed. As flexibility of the ocular muscles develops, the circle is increased in size and faster rotations used.

All work is done at the near point, with the target ten to four-

teen inches from the patient. This also agrees with our own findings, for we have little success with exercises when using a target two or three feet or more from the patient. After a time, exercises at greater distances can be employed and are advisable, but not until attention, fixation, motility and some degree of binocular co-ordination are well established.

But it is not the following by the patient's eyes of the rotating target, *per se,* that is the secret of the remarkable success of the Arneson technic, even though that target shows great acumen and originality on the part of its inventor. It is the use of heavy prisms in conjunction with the rotation that breaks the tetany. In a case of convergent squint, either monolateral or alternating, Arneson commences with 6$^{\Delta}$, bases-in, over each eye, soon increases this to 10$^{\Delta}$, later to 15$^{\Delta}$, and by successive steps up to the astonishing power of 50$^{\Delta}$ over each eye. The same procedure is followed in the cases of divergent squint, but, of course, with the prisms bases out. The writer was amazed to see case after case with an abducting and inducting ability of 100$^{\Delta}$ at all distances from 10 inches up to 20 feet. That such a duction ability is possible casts many shadows of doubt on the ideas we have been entertaining.

The use of strong base-in prisms in convergent squint and strong base-out prisms in divergent squint has been the essential factor developed by Mrs. Martin of Utica, N. Y., and by McCulloch of Holyoke, Mass. The remarkable success of both these refractionists, who, working independently, have hit on the same fundamental law, though their technic is not quite identical, is sufficient evidence of the correctness of the principles involved. The first thing that impressed me, that made me sense that Arneson's methods were sound and workable, was the notation of the heavy reversed prisms before his patients' eyes while they were exercising.

Instead of relying on the patient's statement that he is able to "fuse" two slightly different targets in order to learn if he is employing his binocular functions, Arneson uses the distorting effect of the strong prisms. We are all familiar with the convexed effect of vision through a pair of strong base-in prisms, with the concaved effect when looking through strong base-out prisms, but no one seems to have thought of making a practical application of that knowledge. In the Arneson technic, when the base-in prisms give a convexed effect to the disk, or, if using the base-out prisms they give a concaved effect to the disk, then we know that the binocular functions, or "fusion" if one prefers that term, are in effect. For this distortion is not in evidence when only one eye, with its receptors, is in use.

This means of ascertaining if fusion is or is not present seems, to the writer, far more definite than our accustomed methods. For most of us have noticed that when using stereoscopic pictures or two slightly different pictures that blend to form a third picture when they are "fused," many persons will get a mental picture of what is

wanted, or of what the combined pictures will form, though they are actually seen in alternation. I have even found that children will tell me what the blended pictures form when one eye is suppressed or even with the squinting eye turned inward or outward; having once learned what it is and that the operator wants them to tell him they are seeing it that way, with childish desire to please they tell him what he wants them to say. And the fusing of two objects identical save in their difference in color, as one red and one blue, is most decidedly uncertain, as we have all learned. Judging from the results obtained, the Arneson method of checking the presence or absence of binocular functioning seems to be the best yet proposed. And it is certain that this method develops the binocular functions much more quickly than any method we have used in the past.

In treating alternating squint, that most difficult of all problems, the Arneson method is to place the rotating disk above and behind the patient, with a mirror placed on either side and a little in front of the patient and tilted at such an angle that both reflect the image of the disk. Then with heavy prisms before the patient's eyes he is taught to alternately fix and follow these rotating images at his sides. This is substantially in accord with the idea proposed by McCulloch and Powers; namely, that the correction of alternating squints centers in the problem of educating both sets of receptors to give attention. McCulloch successfully accomplished this with the Kratometer by moving the prism slides up and down with extreme rapidity, thus presenting to both retinae a series of rapidly moving images, compelling attention from both sets of receptors, and finally so speeding the alternation of attention that it becomes practically non-alternating.

As we proceed with our investigations, it is more and more strongly forced on us that our so-called "fusion faculty" is in fact a mental ability to blend a series of pictures "seen" in rapid alternation. Thus, it may be logically assumed that the difference between the cases of alternating suspension or suppression and the normally functioning pair of eyes is only in the degree of speed of alternation. Though this statement must be modified by our now proven knowledge that normally the alternation is between "patches" of the two retinae, or the two sets of retinal receptors, while in totally alternating suppression the alternation is between the entire surface of the two. With alternating convergent squint, we have the added complication of underdeveloped external recti. But any method that will attract simultaneous attention, or, better, practically simultaneous attention, in the two sets of receptors will force such reciprocal innervations that these external recti develop to normal tonicity and functioning.

This is the basis of the technic proposed by McCulloch for the treatment of alternating squint with the Kratometer. Later, Powers of Buffalo, working independently, developed the same technic. The

success of these two men in straightening alternating squints proved the correctness of their principles. The great trouble with this, however, is the great length of time required. Now, with the Arneson technic, which is based on the same principle, but employs a different apparatus, the time element is greatly reduced and there is a higher degree of insurance of results. In fact, I believe that Arneson has a 100% record results. In fact, I now think that the Arneson technic is capable of pretty close to a 100% record for alternating squint. This may seem a rather brash statement, but I believe it justifiable. It is made only after thorough investigation, interviews with patients who have been successfully treated, interviews with patients now under treatment, careful observation and study of the methods. The principle is so sound, the technic so apt, that, aside from some very unusual case different from the types we usually meet, it would seem that there can be no other reason for failure, if the operator employs intelligence in his treatment procedures, than an occasional patient's being unable to complete the course of training. Quite aside from its value in correcting convergent and divergent unilateral squints, in the Arneson technic for the correction of alternating strabismus we have received a boon of inestimable value.

The McCulloch-Peckham technic of using heavy prisms with red filters, for constant wear, was given in considerable detail in Vol. 3, *American Academy of Optometry,* and in the August (1929) issue of the *Optical Promoter,* and therefore need not be presented here. The Arneson exercising apparatus and technic is complementary and supplementary. Or, it can be put the other way, the McCulloch-Peckham technic is supplementary to the Arneson methods. Used in conjunction, the strong prisms and red filters worn continually and the daily or bi-weekly rotating exercises with very heavy prisms, we are finding prompt response and very rapid improvement. I feel very confident that the union of these two systems has carried us many steps beyond the point at which we were a few years ago.

Those who are familiar with the rapid increase of vision following the use of properly placed prisms, bases-out in arrested development cases and absolute hyperopia, bases-in for myopes and for manifest hyperopia with low acuity, can appreciate that with the use of Arneson's methods vision in the amblyopic squinting eye develops very fast. Again we combine the Arneson methods with those we have developed in the last five years to the increased efficiency of both.

But here is an oddity. McCulloch and I have found that it is usually necessary, by the methods we have found successful in straightening squints, to develop vision in the squinting eye to equality, or near to equality, with the other eye. But Arneson has had the uniform experience that when vision in the squinting eye has developed to 20/L or 20/XL, the eye is straight. Probably this is due to difference in aim in the two methods. For our aim was to develop attention and vision, then the central system was sufficiently

disturbed to break the tetany and establish normal reciprocal innervations. Arneson's aim, as he expressed it to me, is to break the tetany by establishing motility, the binocular functions being then quickly established though the fullest degree of vision is not awakened. That fusion and stereoscopic vision can and often are present even when one eye has as poor vision as 20/LXXX, we proved some years ago. This substantiates Arneson's statement that it is not necessary to continue training exercises to the point of perfect vision. However, the writer feels that it is very much better to bring the two eyes to parity if possible.

To sum up, then, the Arneson method breaks the tetany more quickly than any technic or apparatus we have investigated, while the McCulloch-Peckham technic develops vision before the reciprocal innervations of binocular functions establish themselves. The two in combination forecast a future in the handling of squint far less troublesome than have been our experiences during bygone years.

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CONSIDERING MUSCULAR ANOMALIES IN STATIC SKIAMETRY*

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The aim in static skiametry is to refract the eyes with accommodation as nearly relaxed as possible. This being the case, we must give due consideration to the co-ordination of the extrinsic muscles of the eye, otherwise complete relaxation is impossible.

It is at the present time a common practice of modern optometrists to make the phoria tests on the patient as a preliminary to the objective examination—the test is made, of course, on the patient with no corrective lenses in place. The muscular condition of the eyes with unaided vision is then known and can be compared finally with the condition as induced by the final prescription and judgment can be made as to the comfort of the patient when wearing the corrective lenses.

Another use can be made of the knowledge obtained in making the phoria tests on the patient with unaided vision, previous to the objective tests. This use is in the static skiametry and enables the examiner to obtain a more relaxed accommodation and consequently a better static skiametric test.

The static skiametry is taken by many members of the profession with the one eye of the patient occluded during the examination, while the other eye fixes. Many others take the static with both eyes of the patient fixing at six meters.

Both these methods are correct but the circumstances under which each should be used are precisely opposite if the muscular condition of the eyes under examination is regarded.

The following procedure works out very well in obtaining a better static finding:

Before starting the examination, the phoria tests should be made and the results recorded, the patient having no corrective lenses before the eyes. The esophoric or exophoric results can now be considered in making the static examination with the retinoscope. Let us assume that exophoria has been found present with unaided vision. In this case, if one eye be now occluded, the other will fix, while the occluded eye diverges. Under these circumstances the accommodation relaxes more fully than when convergence is adjusted for infinity, because the initial positive convergence is now not working and consequently not inducing accommodative action. Thus, if exophoria is present with unaided vision, the static examina-

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tion should be accomplished with one eye occluded. In this manner it will be found that more plus will be uncovered in hyperopes and less minus in myopes, and the static correction found will be more nearly exact than if taken by other methods. The examiner, of course, must be refracting as close to the visual line as possible.

Now let us assume esophoria to be the muscular imbalance with unaided vision. In this case, binocular fixation at six meters will insure the most relaxed accommodation, for if one eye be occluded, the other will converge, so that accommodation is induced and we have not a truly static finding.

Thus we have the proper procedure. In cases of exophoria, occlude one eye when conducting the static skiametry, and in cases of esophoria, have both eyes open and binocular fixation at six meters or more.

In cases of orthophoria and any appreciable hyperopia is shown at first glance with the retinoscope, then proceed with one eye occluded, because the addition of plus lenses will probably induce an exophoria.

In cases of orthophoria with myopia indicated at first glance with the retinoscope, then proceed with binocular fixation at six meters because, if anything, an esophoria will be created with the addition of minus lenses.

The above method can be followed with no difficulty whatever and a static prescription which is more nearly static will be obtained.

Having now obtained a truly static finding, it may be found that the patient will falsely demand less plus or more minus in the subjective binocular test. If such is the case, then a low power prism placed base-in will often enable the patient to accept the slightly higher plus or the weaker minus corrective lenses. This prism may then be incorporated in the final prescription, if found to be of a moderate amount.

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LATENT HYPEROPIA*

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This paper will endeavor to explain three near point methods of determining the presence of and measuring the amount of Latent Hyperopia.

The three methods are named after their originators. These are Dr. Tait's method, Dr. Peckham's method, and our own Dr. Robert N. Walker's method. There is of necessity a basic similarity in all three of these methods, because of the ever-present convergence-accommodative relationship. Two of the three methods, Dr. Peckham's and Dr. Walker's, are purely subjective, while Dr. Tait's is both subjective and objective.

None of these tests can be made satisfactorily with the trial frame. Dr. Tait's can be made clumsily with the trial frame, but the other two require a battery of lenses and prisms.

First we will consider Dr. Tait's method. Place strong plus lenses (four or five diopters) before the patient and with Dynamic Skiametry at 13 inches gradually reduce the lens power until neutrality, or the fastest against motion is obtained. Then subtract 1.50 D. sphere from this and take the physiologic exophoria. If there is 6$^{\Delta}$ or less of physiologic exophoria found, this lens power, that is, the Dynamic findings working down to neutrality minus 1.50 D. sphere, is the measure of the total Hyperopia, manifest and latent.

Remember that the physiologic exophoria is not just the exophoria at near but is the difference between the phorias at distance and at near. That is, if there is an exophoria at distance, you subtract it from the exophoria at near to get the physiologic exophoria, and if there is an esophoria at distance you add it to the exophoria at near to get the physiologic exophoria.

But if more than 6$^{\Delta}$ of physiologic exophoria is found at 13 inches when 1.50 D. Sph., is subtracted from the Dynamic findings at 13 inches, working down, more than 1.50 D. Sph. must be subtracted from them. For every 2$^{\Delta}$ more than 6$^{\Delta}$ of physiologic exophoria found 0.25 D. Sph., more than 1.50 D. Sph., must be subtracted from the Dynamic findings. That is, if 8$^{\Delta}$ of physiologic exophoria is found when 1.50 D. Sph. is deducted, then 0.25 D. Sph. more, or 1.75 D. Sph. must be deducted from the Dynamic findings. If 10$^{\Delta}$ of physiologic exophoria is found then 0.25 D. Sph. more, or 2.00 D. Sph. must be deducted from the Dynamic findings. If 12$^{\Delta}$

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of physiologic exophoria is found then 0.25 D. Sph. more, or 2.25 D. Sph. must be subtracted from the Dynamic findings. If 14Δ is found, subtract 2.50 D. Sph. If 16Δ is found, subtract 2.75 D. Sph. And if 18Δ is found, subtract 3.00 D. Sph. If 18Δ is found then there is no convergence in use and the test is the same as a Static Skiametry test, so you subtract + 3.00 D. Sph. for the working distance of one-third of a meter.

Let us make up a few illustrative cases.

Say we place a pair of + 5.00 D. spheres before the eyes, and have to reduce them to + 4.00 D. Sph. o. u. before we get neutrality. Then we deduct + 1.50 D. Sph. from this, which leaves + 2.50 D. Sph. Then we take the distant phoria and find 1Δ of esophoria and then find 5Δ exophoria at near. That makes a physiologic exophoria of 6Δ. Therefore the + 2.50 D. Sph. measures the total amount (both manifest and latent) of the Hyperopia, because the physiologic exophoria is not more than 6Δ.

Let us take another case. Let us again find neutrality, working down with + 4.00 D. Sph. o. u. Then as before we deduct 1.50 D. Sph. which leaves + 2.50 D. Sph. Then we take the physiologic exophoria by taking the difference between the distant and near phorias. Suppose we find 10Δ of physiologic exophoria this time. Remember we said that for every 2Δ more than 6Δ of physiologic exophoria we found we were to subtract 0.25 D. Sph. more than 1.50 D. Sph. from the Dynamic findings. 10Δ is 4Δ more than 6Δ. Therefore we deduct 0.50 D. Sph. more than 1.50 D. Sph., or 2.00 D. Sph. from the Dynamic findings of + 4.00 D. Sph. which leaves 2.00 diopters of total Hyperopia. You see this case has ½ diopter less than the first case because there was 4Δ more of physiologic exophoria when 1.50 D. Sph. was deducted from the Dynamic findings.

Let us consider why we first deduct 1.50 D. Sph. from the Dynamic findings. As you all know, we have to consider ciliary tonicity and lag of accommodation behind convergence in Dynamic skiametry. Ciliary tonicity, or the normal tone of the ciliary muscle, decreases from 1.25 D. Sph. at 10 years of age to 0.25 D. Sph. at 40 years. The lag of accommodation behind convergence increases from 0.25 D. Sph. at 10 years to 1.25 D. Sph. at 40 years. If you add the two factors together at 10 years you get 1.50 D. Sph., or if you add them together at 40 years you get the same 1.50 D. Sph., or if you add them together at any age between 10 and 40 you get the same 1.50 D. Sph. because the ciliary tonicity decreases at the same rate that the lag of accommodation behind convergence increases. Since we are working down to neutrality we must allow for both of these factors, the sum of which is 1.50 D. Sph. at any age between 10 and 40.

The reason the test is based on 6Δ of physiologic exophoria is because most investigators have found this to be the normal amount.

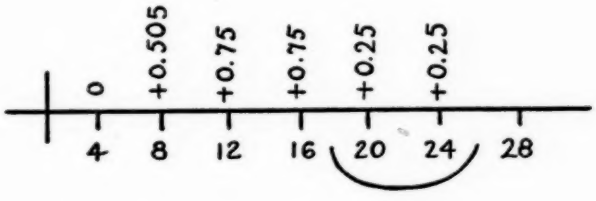
This test is not to be used after 40 years because presbyopia affects the Dynamic findings. Dr. Tait said that in 98% of the several

thousand cases this test has been used on at Pennsylvania State College of Optometry it has given satisfactory results.

We will now go on to Dr. Peckham's method and as mentioned before. This is purely a subjective test. Stated simply, it consists of turning in base-in prisms and adding plus spheres. The relationship between convergence relaxation and accommodative relaxation is noted as the prisms and plus spheres are turned in.

After you have gotten the distant correction you turn in as much more plus as will be accepted at near. With this in place you direct the attention to a test object (preferably a small picture with a lot of detail) placed at 13 inches and turn base-in prisms slowly until the image begins to blur. When the patient says it begins to blur stop, and note how much prism you have turned in. This is the relative convergence relaxation (R. C. R.). The less you have turned in the more the latent hyperopia needs correcting. Then you see how much plus power you can add without blurring the image and make a note of this. Then you add 2Δ more base-in over each eye (4Δ in all) and then add as much more plus power as will be accepted. Keep this up, alternately adding base-in prisms in steps of 4Δ and as much plus as will be accepted at each prism step until diplopia occurs. Make a note of all these findings as you go along. I will in a moment explain the best way to keep all this data. When diplopia occurs gradually reduce the prisms until single vision re-occurs, and make a note of the recovery point. The total amount of plus power added before the proportion of plus spheres to base-in prisms begins to decrease is the measure of the amount of the latent hyperopia that needs correcting.

Case No. 1.

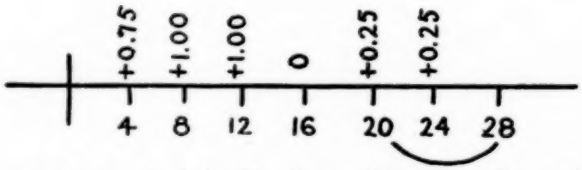


Let us take a few illustrative cases.

The Relative Convergence Relaxation (that is the amount the convergence relaxes before the accommodation relaxes any) is low (8Δ), so plus power is needed. The amount of the latent hyperopia that should be corrected besides the amount that was accepted at near without any prisms is 0.50 + 0.75 + 0.75 = 2.00 diopters Sph. The proportion of plus power to base-in prisms began to decrease

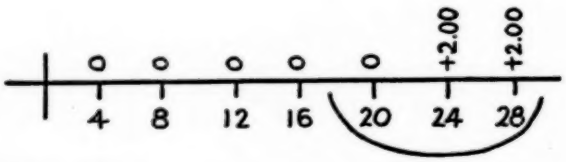
at 16Δ, so the Latent Hyperopia should only be corrected through here.

Case No. 2.



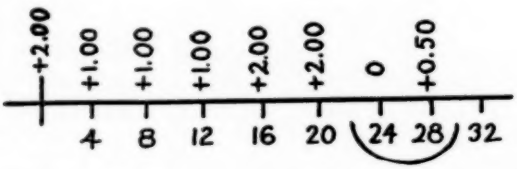
Plus power is needed badly here, because the relative convergence relaxation is only 4Δ. The amount of Latent Hyperopia that should be corrected in this case is 0.75 + 1.00 + 1.00 = 2.75 D. Sph. The quarter that was accepted at 20Δ and the quarter that was accepted at 24Δ should not be corrected, because the proportion of plus power to prisms base-in decreased at 16Δ.

Case No. 3.



None of this should be corrected because the relative convergence relaxation is high (24Δ). So you see the amount of the relative convergence relaxation determines whether or not the Latent Hyperopia needs correction.

Case No. 4.



The amount that needs correcting besides the + 2.00 D. Sph. that was accepted at near without any prisms is 1.00 + 1.00 + 1.00 + 2.00 + 2.00 = 7.00 D. Sph. The final correction in this case (which is one of Dr. Peckham's) was + 9.00 D. Sph. o. u.

The relative convergence relaxation should be as much as the prism diopters of convergence for comfort. Dr. Peckham says that enough of the Latent Hyperopia to make the R. C. R. as much as the P. D. of convergence *must* be corrected.

After Peckham's convergence-accommodation relaxation test is made the prisms and spheres should be reduced slowly to see if more plus power will be accepted at distance than was at first.

We will now consider Dr. Walker's test. Do not think that Dr. Walker just revised Dr. Peckham's test. He did not. In fact he

had his test worked out before he knew anything about Dr. Peckham's. He is due full credit for working his test out alone.

With his test you first get the distance correction and have the patient fix an object at 13 inches just as in the other test. We use a small white cross, as illustrated.

This is drawn on a large black card. The patient does not see the edges of the card which reduces the physiological factor of nearness. Then you turn in a vertically doubling prism (6$^{\Delta}$). Give the images plenty of time to come to rest and take the phoria by turning in prism power enough to align the images. Then add + 1.00 D. Sph. o. u. and wait for a moment. You will find that it takes more prism base-in to align the images. Make a note of the amount and turn in + 1.00 D. Sph. more o. u. and wait again. You will then find that it takes more prism base-in to align the images. Make a note of the amount and turn in + 1.00 D. Sph. more o. u. (which makes +3.00 D. Sph. that has been added) and after a few moments slowly turn in enough prism power again to align the images.

Now if there is no Latent Hyperopia present you will find that you have turned in as much prism power base-in to align the images as the patient has to converge to fix at 13 inches if he had orthophoria at distance. But if Latent Hyperopia is present you will find that you have not turned in as much prism power base-in as he converges to fix at 13 inches (still assuming orthophoria at distance).

You all know how to calculate the number of prism diopters of convergence that is used in a given case. It is done by multiplying the meter angles of convergence by the interpupillary distance in centimeters. You know the meter angles of convergence corresponds to the spherical diopters of accommodation. That is, there is one meter angle of convergence at one meter, two meter angles of convergence at one-half meter and so on. So if there is an interpupillary distance of 6 cm., there is 3 times 6 or 18 prism diopters of convergence at 13 inches. If there is an interpupillary distance of 6.5 cm. there is 3 times 6.5 or 19.5 prism diopters of convergence at 13 inches.

So if a patient has an interpupillary distance of 6 cm. you would expect that it would take 18 prism diopters base-in to align the crosses at 13 inches with 3.00 D. Sph. added to the distance correction if there is orthophoria at distance and no Latent Hyperopia.

Now let us consider how to interpret the findings if there is less convergence relaxation with the 3.00 D. Sph. added than there is prism diopters of convergence when the patient fixes at 13 inches. The way Dr. Walker interprets the findings is to allow one spherical

diopter for every three prism diopters deficiency of convergence relaxation. To be exact you should allow one spherical diopter for every 2½ prism diopters if the interpupillary distance is 50 mm., and one spherical for every 3½ diopters if the interpupillary distance is 70 mm. But since the interpupillary distance is usually nearer 60 mm. than it is either 50 mm. or 70 mm., one spherical diopter is allowed for every three prism diopters for simplicity. This is not the old 3 to 1 relationship of convergence to accommodation of Dr. A. J. Cross, which assumed that each eye converged 3 prism diopters when it accommodated one spherical diopter. Dr. Walker found that with his technique about half of the convergence is accommodative and the other half fusional. Therefore if there is 18Δ of convergence and 9 of it is accommodative, the relationship of convergence accommodation to accommodation is 2 to 1. Taken in the usual way about two-thirds of the convergence is accommodative and the other one-third fusional, but with this technique more of the accommodation or about one-half is fusional.

Let us take a few illustrative cases:

Case No. 1.

Interpupillary distance = 63 mm.
Distance phoria = orthophoria.
Phoria at 13 inches with distant correction = 6 (9) Exo.
Phoria at 13 inches with 1.00 D. Sph. added = 9 (13) Exo.
Phoria at 13 inches with 2.00 D. Sph. added = 14 (16) Exo.
Phoria at 13 inches with 3.00 D. Sph. added = 17Δ Exo.

If there had been no Latent Hyperopia you would expect to find 3 times 6.3 or approximately 19 prism diopters of exophoria with the 3.00 D. Sph. added. But we found only 17 or 2 prism diopters less. Since we are allowing one-third spherical diopter for each prism diopter, we would estimate the Latent Hyperopia to be 2 times ⅓ or ⅔ diopter. The reason we took the exophoria as we took off the plus power (shown by the numbers in parenthesis) was to see how much more exophoria we would get working down than we did working up. If we got much more exophoria working down than we did working up we would not expect to have much trouble relaxing the Latent Hyperopia, because the convergence relaxes easily.

Case No. 2.

Interpupillary distance = 66 mm.
Distant phoria = 2Δ esophoria.
Phoria at 13 inches with distant correction = 2 exo. (2).
Phoria at 13 inches with 1.00 D. Sph. added = 5 exo. (5).
Phoria at 13 inches with 2.00 D. Sph. added = 8 exo. (9).
Phoria at 13 inches with 3.00 D. Sph. added = 11 exo.
Total convergence relaxation is 11Δ plus 2Δ of 13Δ.
3 times 6.6 equal 19.8 or approximately 20.
20 minus 13 equals 7.

7 times ⅓ equals 2⅓ which is the number of diopters of Latent Hyperopia. You will notice that when the plus power was taken off the phoria came down to what it was before. This indicates that it will be hard to relax the Latent Hyperopia.

Case No. 3.

Interpupillary distance = 57 mm.
Distant phoria = 2Δ exophoria.
Phoria at 13 inches with distant correction = 5 (8) Exo.
Phoria at 13 inches with 1.00 D. Sph. added = 8 (11) Exo.
Phoria at 13 inches with 2.00 D. Sph. added = 11 (13) Exo.
Phoria at 13 inches with 3.00 D. Sph. added = 14 Exo.

Total convergence relaxation is 14 minus 2 = 12Δ (2 exophoria at distance).

3 times 5.7 equals 17.1 (convergence relaxation if there had been no Latent).

17 minus 12 equals 5.

5 times ⅓ equals 1⅔, which is the number of diopters of Latent Hyperopia in this case.

One detail of this test that has not been mentioned is that the P. D. of the instrument should be increased to distant P. D. when the plus three is added to eliminate the base-in effect of the spheres.

We have discussed three ways of measuring Latent Hyperopia. The next question is what are we going to do about it after we have measured it. The answer is—correct all of it that needs correcting. I have previously said that Peckham advises us to correct all that is revealed up to where the amount of plus sphere for each four prism diopters added, begins to decrease. The next question is how are you going to make the patient accept the correction? That is a hard question. Here is Peckham's answer to it.

Measure the patient's distant outduction and recovery. Place one-third of the distant outduction recovery and the total amount of plus you are going to try to make him accept before his eyes and have him fix an object (preferably a picture) at 13 inches. Then gradually move the object away and substitute larger objects when necessary and gradually reduce the plus power so the object may be seen clearly. Do not reduce the prisms. Leave one-third of the distant outduction recovery in place all the time. When you have gradually moved the test object away to 20 feet you should find a little more plus in place than he accepted before. Prescribe this with the same prism power (one-third outduction recovery) with the balance of the Latent Hyperopia correction you are trying to get him to accept in a bifocal add.

Have him wear this sphero-prism-bifocal correction for a month and return. Then go through the whole test again and get as much of the bifocal add into the distance part of the lens as you can. Include prism power of one-third of the new distant outduction

recovery in the correction as before and have him return again in a month. Change the correction each month or as often as you can until he accepts the total correction for distance. If the Latent Hyperopia does not relax fast enough give him daily prism base-in exercises which will make it relax quicker.

Now let us take an illustrative case. Patient accepts + 1.00 D. Sph. by ordinary subjective methods, but our tests show us that he ought to be wearing + 2.50 D. Sph. We find his distance outduction recovery to be 9 prism diopters. We place one-third of 9, which is 3 prism diopters, base-in in the phoropter (1.5$^{\Delta}$ over each eye) and + 2.50 D. Sph. before each eye and have him fix a test object at 13 inches. We slowly move the test object away and reduce the spheres. We find that he accepts + 1.25 D. Sph. for distance, which is a quarter diopter more than he accepted before. Now we are ready to write his first prescription. It will be:

O. U. + 1.25 D. Sph. $\supset$ 1. 5$^{\Delta}$ prism base-in add + 1.25 D. Sph.

After one month we find that we can change this to:

O. U. + 1.50 D. Sph. $\supset$ 2.00$^{\Delta}$ prism base-in add + 1.00 D. Sph.

After six months we find that we can change this to:

O. U. + 2.50 D. Sph. $\supset$ 2.00$^{\Delta}$ base-in.

After another year we find that we can change this to:

O. U. + 2.50 D. Sph.

If the patient is an exophore you may give more than one-third of the distant outduction recovery in base-in prisms if you find that the Latent Hyperopia is not relaxing fast enough. You may give one-half of the distant outduction recovery in base-in prisms if you give him base-in exercises when you deliver the glasses and daily thereafter for a few days.

You will notice that we have said nothing about blurring or fogging the latent Hyperope. Experience has proven that doing so does not hasten relaxation. With our present knowledge it seems that base-in prisms and bifocals offer the best solution to the problems of Latent Hyperopia.

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SOME COMMENTS ON HEREDITY IN RELATION TO OCULAR PERVERSIONS*

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Adolph Weissman, of the University of Breisgau, in his works "On Heredity," defends the proposition that an acquired characteristic cannot be transmitted as an hereditary trait, and that all gains or losses rest alone on the principle of natural selection, expounded, I think, by Darwin.

Admitting a personal incompetence to refute the beautiful arguments of Weissman, I am inclined to accept his doctrine as true. I think, then, we shall all have to modify our hopes of influencing the ocular states to a higher perfection in respect to oncoming generations, unless and until the science of bio-chemistry shall have first had its say.

Undoubtedly, many of us have entertained the idea that could we but carry out ocular prophylactic and hygienic measures early enough in the lives of future parents, especially the mothers of tomorrow, we could materially aid in eliminating many of the disturbing and distressing conditions which our science is destined to combat. I have particularly in mind the ocular imbalances, or cross-eye, improperly so-called.

In the light of the foregoing, I believe we shall have to modify our views in respect to the causation of myopia, as well as other ocular defects. Germans are notoriously myopic. The reason therefor has been given that the Germans have acquired the defect because they are an highly intellectual people given to use their eyes persistently at close range. This intellectually unintelligent habit of anyone to indulge a persistent force, while condemnable, cannot be the true answer, if Darwin and Weissman are right—and most authorities hold they are undeniably right. And, yet, it can hardly seem to rest on the relatively slow process of natural selection, if we consider that the occasion for persistent use of eyes at close range has been for a matter of but a few hundred years.

In casting about for some other causative factor or factors, I am rather impressed with the fact that not much attention has been given to effects of a chemistry that might be habitually modified and that might have an accelerating effect in respect to morphological constituents. It is now that I regret that I have not more than a hand-shaking acquaintance with chemistry. At any rate, I submit the following ideas or notions, be they right or wrong, in the hope that they may have a proper contagious effect and serve some useful purpose.

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At times, our attention has been attracted to cases of wood alcohol poisoning resulting in blindness. We know more or less of the effects of alcohol of another variety in producing illusions, delusions, and hallucinations. It seems remarkable that alcohol has an apparent affinity only for either the cells of the visual sensorium or the optic thalimi. I take that as a truth, since we do not often hear of an obliteration of the other senses. That the optic thalimi are involved by grain alcohol may be adduced from the disruption in co-ordination of the faculties resulting in delusions and hallucinations.

Obviously, alcohol is stimulating in relative degrees, depending on its nature, quantity, and individual affinity. The stimulation affects the senses, and, probably, stimulates the vegetative processes of the cell, directly or indirectly. Without thought of disparaging a great people, Germans and grain alcohol appear to have a happy affinity for each other, applicable alike to both sexes.

The peoples of France and Italy use natural ferments freely. I do not know if both sexes indulge freely. In my own limited experience, I have come to believe that these people have well-balanced eyes. Yet, if the processes of natural selection were the only influential factor, all three peoples ought show about the same relative ocular state.

Among those peoples whose male members alone use unnatural ferments, it is not unreasonable to expect an heterogeneous states in respect to eyes. I believe that, were total abstinence practiced, it would nevertheless persist until modified under the principle of natural selection. The engines for the metamorphosis of force having been built, will have to be modified to step-up or step-down the vegetative processes.

It seems to me that some important research work of great value is herein indicated.

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OCULAR ELECTROTHERAPY

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Chapter X.

General physiological considerations from an electrical standpoint. Studying the physiology of the human body and its various organs, it may be compared to a modern symphony orchestra; the organs representing the various instruments, while the individual players may be likened to the peripheral nerves and ganglia of each organ. All these in turn are controlled and supervised by the conscious intelligence through the central nervous system, the same as the orchestra is controlled by its conductor.

When any one function is suppressed or altered, the entire body equilibrium is disturbed just the same as when one single instrument plays out of tune, it destroys the harmony of the entire orchestra.

Human organism is dependent for its growth and functional activity, upon potential energy which is stored up in the food. This food is derived directly or indirectly from vegetable substances. The vegetable organisms receive their energy directly from the sun. All energy, it is claimed comes directly from the sun in the form of radiant light and electrical waves. This heat is in turn absorbed by the vegetables, and is used to break up carbon dioxide, from the atmosphere, into carbon and oxygen. The oxygen is given off back to the atmosphere while the carbon is combined with water to form the organized structure of the plant or tree. Through the process of the transformation of energy it is thus transformed into potential chemical energy which is stored up in the carbon of the plant on the one hand and the freeing of the oxygen on the other. This stored up energy is used for the performance of the different physiological functions in the animal organism. When one is lifting a weight the energy expended in this act involves the recombination in the muscle fibers of the carbon obtained from the digestion of food and the oxygen brought from the lungs by red blood corpuscles.

Analyzing the above facts, we can see that the main difference between animal and vegetable organism is this: the plant absorbs the active solar energy and breathes CO_2, returning oxygen to the atmosphere and is building up carbon compounds in which is stored up potential energy. Animals break down vegetable compounds which are burned up in the cells of the organism with oxygen from the air, the stored-up energy being liberated in an active, or kinetic form, and carbon dioxide is returned to the atmosphere.

We are all fully aware of the fact that the proper digestion and absorption of food and a sufficient supply of oxygen are esential factors, in the maintaining of health in the human organism, still there are other factors at work, which modern science is beginning to recognize. More and more is it becoming an accepted fact that the whole scheme of creation involves the action of some special force which may be called "LIFE FORCE" or "VITAL ENERGY." Evidence is fast accumulating which tends to prove the contention of many scientists that this "LIFE FORCE" or "VITAL ENERGY" is produced by electricity. Crile[32] conducted a considerable amount of research along this line and he claims that it is electricity that keeps the "flame of life" burning in the cell and the flame (oxidation) supplies the electricity which is the "Vital Energy" of the animal. Life, he considers to be a state of imbalance between the positive and negative electrical elements in the protoplasm.

Living organism, according to Crile, are "bi-polar electric mechanisms" and to prove his contentions he offers the following facts:

1. It is an established fact that electricity is a constant phenomenon of living processes.

2. That the application of electricity to the muscles or glands or their nerve supply will cause them to perform their natural functions. This fact is universally accepted by physiologists.

3. That the material of which animals are constructed are especially adapted to electrical processes. Certain generally known facts regarding the principal constituents of the body are made available through recent laboratory experiments.

4. That in structure and function the unit cells which drive the organism not only are adapted to fabricate, to store up and to discharge electricity, but this is also true of the protoplasm itself.

5. That the organism, as a whole, is a bi-polar electrical mechanism bearing the pattern of a unit cell and that the unit cells are constructed on the pattern of the atom. There is sufficient experimental data available to prove this contention.

6. That normal and pathological phenomena of man and animals can be interpreted in electrical terms.

Physiologists and biophysicists have long recognized the fact that electro-chemical processes play a very important part in the phenomena of life. Physicists observed the similarity of the *nerve current* to an *electric current* as soon as the characteristics of the production and conveyance of electric currents began to be recognized.

Becquerel, a French physicist from his experiments on the action of electricity on organic bodies, draws the conclusion "That there are sufficient facts to show that electricity probably plays a great role in the animal economy, and it should also be included among the means whereby life is maintained in organized bodies. But in what way do these bodies, when they begin to develop, put into action these electric principles, whose action persists throughout

their life? Of this we are completely ignorant. This is, without doubt, one of the mysteries of creation, which men will never be able to fathom."

Donne from his experiments, reached the conclusion: "That electric currents exist in animals at the surface of the membrane and in the various organs. This theory rests on the principle that when two bodies, one acid and the other alkaline, are separated by a membrane, a multitude of electric currents continually work through this intermediary. Electricity acts in two ways within the animal economy. It may produce contractions and other derangements of the equilibrium of the organic parts, or it may control the chemical reactions which either promote the secretions or are prejudicial to their production."

Nernst[33] in describing the action of an electric current contends that the electrolytes in the axis cylinder lie within membranes which are impermeable to certain ions, and that when an electric current is passed through a nerve, it is conveyed by the disassociated electrolytes, causing an accumulation of positive ions at one point and of negative ions at another. When the concentration reaches a certain point excitation occurs. Space will not permit to quote the findings of more investigators and the conclusions by eminent authorities on this subject. This will, however, suffice to support the contention that the "VITAL ENERGY" is produced by electricity by means of which energy is liberated for every activation of the human organism.

Through the action of this great force electrons are formed into atoms; atoms into molecules; moleclues into crystals and chemical compounds; and these in turn form into the cells and bodies of plants, animals and man. With the progress and development of modern science more and more recognition is given to the existence of this *force*. Simple animal organism like the amoeba, and simple cells of the embryonic type appear to possess the power of absorbing vital force from food and air and of using it in maintaining their functions of growth, reproduction, etc. Some cells lose this power of direct self-vitalization and must be sustained by stimulating forces carried to them from the nerve centers. These are usually highly specialized cells, such as muscle and nerve fibres. The vitalizing centers, which furnish the sustaining force to the specialized cells, are situated in the anterior horns of the spinal cord for the motor nerves and voluntary muscles, and in the posterior spinal roots, for the sensory nerves. To the visceral organs and to the unstriped muscles the life force is distributed through the sympathetic nervous system.

There are several functions involved in the preparation and distribution of the food material and oxygen, some of these are:

1. The digestive system.
2. The absorbent system.

3. The distributing system.
4. The respiratory system.
5. The excretory system.

The digestive system has for its function to soften the food and render its soluble by chemical ferments. The absorbent system takes the digested food from the intestine and transfers it to the blood stream. The distributory system includes the blood vessels and the lymphatics, which carry the absorbed nutrition to all parts of the body. The respiratory system is composed of the lungs which draw in oxygen and the red blood corpuscles which carry this oxygen to all parts of the body. The excretory system has for its function to free the body from the burned up cell debris and the products of tissue combustion. The CO_2 is thrown off by the lungs while the red corpuscles are continually absorbing new supplies of oxygen. The white blood corpuscles pick up the solid waste products and carry them up to the spleen where they are burned up. The leucocytes are known as the "police" of the body, they pick up and carry away disease germs and poisons which may be introduced into the body accidentally and they protect the body in many other ways. They form a wall and prevent foreign matter from gaining access to the blood stream, whenever there is a cut or a bruise in any part of the body. In the same way they also surround colonies of disease germs, thus checking their development and protect the surrounding tissues.

The functions which are here enumerated are maintained and regulated by *vibrations* and *oscillations,* transmitted through the sympathetic nervous system, which consists of a double chain of nerve ganglia and filaments radiating from the great centers.

We have thus far considered the different processes by which the cells and tissues of the human body are supplied with the potential energy necessary for the performance of their respective functions. We shall now briefly describe the dispersion of the energy taken in with the food and air.

The most important of these functions converts the potential energy supplied by the food, into active or kinetic mechanical force. This function has its seat in the muscular system, which comprises (a) the *voluntary muscles,* these muscles contract under the influence of a conscious impulse, sent from the brain to the motor nerves through the spinal cord; (b) the *involuntary muscles,* which are independent of any conscious impulses; they are associated with mechanical processes incidental to digestion, circulation and respiration. They are operated by vibrations transmitted through the nerves of the sympathetic system. The stored up energy is also distributed through the sensory mechanism. We are enabled through the sensory nerves, to come into conscious relation with the objective world which we interpret through *vibrations* of different types of *frequencies.* The various types of nerves whether sensory, motor

or sympathetic, transmit to their respective organs and tissues a peculiar vitalizing influence called *"Vital Force."* This action, which was formerly believed to possess a special system of nerve filaments is now known to be a common function of all nerves, that is, each nerve possesses a *"vital center"* which continually supplies the nerve and its respective tissues with the peculiar vibratory force necessary for their growth and vital action. F. F. Strong[34] claims that almost all parts of the body are provided with sensitive, bulb-like structures called *"tactile corpuscles"* each of which is connected to a sensory nerve filament which passes through the spinal cord to the centers of sensation in the brain. These filaments pass through large nerve cells in the spinal cord which act like *batteries supplying energy for the vibratory impulses which cause sensation.*

The exact nature of sensory nerve impulses is not known. It is probable, however, that each sensory nerve with its terminal bulb acts somewhat like an electrical condenser, and that stimulation or irritation of the nerve-ends cause this condenser to discharge, producing oscillations of a definite frequency, varying in intensity or amplitude according to the degree of stimulation. Slight contact between the skin and a soft substance would set up faint oscillations, which would be transmitted to the brain and interpreted as a delicate tactile sensation; severe irritation of the skin, on the other hand, probably causes a complete "short-circuiting" of the nerve condenser, resulting in oscillations of great intensity, which give rise to a conscious sense of local pain.

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THE CAUSES OF PRESBYOPIA*

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The subject of presbyopia enters the professional life of every optometric practitioner. Because of this, it is indeed well to know all that we can about it. Up to the present time, the known causes of presbyopia are:

1. Sclerosis of the lens: (a) Physiologic; (b) Pathologic.
2. Hypotonicity of the ciliary.

Physiologic lenticular sclerosis may be considered as that which occurs as a normal condition with advanced years.

Pathologic lenticular sclerosis is that brought about by systemic disorders such as diabetes, nephritis and other diseases. It may also be caused by trauma, such as traumatic cataract.

Hypotonicity of the ciliary is a condition found in anyone with a run down condition due to either over work, dissipation, or numerous systemic diseases.

Before considering the next cause, it would be well to mention that the writer is among those who uphold the Helmholz theory of accommodation. In healthy individuals of presbyopic age sclerosis of the lens is not always the existing cause of presbyopia. We know this because very many healthy presbyopes can force accommodation for their reading point or can be made to force accommodation for their reading point by base-out prisms. Dynamic skiametry also proves this. If the Helmholz theory is correct, then accommodative effort by the ciliary would not cause the lens to bulge if sclerosis of the lens existed.

Before going any further, let us analyze the accommodative mechanism.

1. Physiologic accommodation (so named by Fuchs) is that effort exerted by the ciliary muscle (meridional radial and circular fibers combined).

2. Physical accommodation (so named by Fuchs) or accommodation proper is the actual change in curvature of the lens surfaces, more so of the anterior surface.

It must be borne in mind that physical accommodation is purely a negative process, if the Helmholz theory holds good, because the lens is simply allowed to relax when the radial, meridional and circular fibers exert their accommodative effort simultaneously and pull the choroid forward.

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If sclerosis of the lens is the only cause of presbyopia in healthy individuals, then it can readily be seen that no presbyope could force himself to accommodate for fixation within the reading distance.

Another form of sclerosis that takes place in arterio-sclerosis. The choroid is very vascular. Because of this, it can readily be seen that arterio-sclerosis in the choroid, will cause it to lose its ease of elasticity, more ciliary effort will therefore have to be used in order to accommodate. Therefore, it may be concluded that another cause of presbyopia in a healthy individual is arterio-scerlosis occurring within the choroid. This will also explain why so much more accommodative effort will have to be exerted for each diopter of accommodation as compared to younger people.

A unique feature involved here is that the acceptance of the arterio-sclerotic cause of presbyopia depends upon and also helps to establish the Helmholz theory of accommodation. If Tscherning's theory were true, then arterio-sclerosis within the choroid would help presbyopes to accommodate because the choroid would be more unyielding.

A case from Graves, British Medical Journal, 1926, establishes the Helmholz theory. In a case where the entire lens had become absorbed after trauma, capsule; he observed by the slit lamp the action of voluntary accommodation, miotics and mydriatics upon this was almost taut; on complete relaxation, it became quite taut; and in the act of accommodation, or on the exhibition of eserine, it became lax and folded upon itself, movements of the eye causing it to tremble.

That lenticular sclerosis exists cannot be denied. Take the cases of uncorrected presbyopes that have a very active accommodation. Perhaps sclerosis is delayed in an active lens. Whereas a presbyope who wears a plus correction allows his accommodative mechanism to rest and thereby may give the crystalline a chance to "set." Evidence of this is seen in permanent lenticular astigmia where no corneal astigmia exists.

In cases that present corneal astigma, the astigmia as found by retinoscopy may have a far different axis than that of the cornea. Flattening of the lens in later years probably is due to the shrinking of the choroid, thereby bringing tension on the suspensory ligament. To the writer's way of thinking, it appears that arterio-sclerosis within the choroid is the only cause of the lens flattening in later years.

The writer believes that the radial meridional and circular fibres of the ciliary act simultaneously. All that any muscle can do is to contract and relax. The relaxation of these fibres will allow the choroid to draw the suspensory ligament tense and taut.

There are two systems controlling accommodation, namely, the sympathetic and para-sympathetic. Clinical evidence proves this as follows: Atropine affects only the para-sympathetic system, which in turn controls the sphincter of the iris and ciliary. Atropine has no ef-

fect on the sympathetic system, which in turn controls the radial and meridional of the ciliary and the radial fibres of the iris. If the individual is of the parasympathetic type, the pupil will dilate and the sphincter of the ciliary will be made to relax. There will be no effect on the radial and meridional fibres. In the sympathetic type, the atropine will have no effect on the sphincter pupillae or the sphincter of the ciliary. In these cases, accommodation is brought about mostly by the radial and meridional fibres. Dr. Tait of the Pennsylvania State College of Optometry reported a case where atropine caused a further stimulation of accommodation.

It would be reasonable to conclude from this that in the sympathetic type when accommodative effort is exerted, it will be done mostly by the radial and meridional ciliary fibres. Because of the fact that the pupillary and ciliary fibres function simultaneously, the radial fibres of the pupil will contract, thereby accommodative effort is exerted. These cases may be observed in practice. The sympathetic types are those with large pupils.

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A FEW NOTES ON SECTIONAL ACCOMMODATION*

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Sectional Accommodation may be defined as the "Ability of the crystalline lens to alter its shape in different meridians." In other words, to so adjust itself that it becomes a compound lens composed of both spheric and cylindric power. The writer has never seen any proof that sectional accommodation is other than a theory, nor does he know of any instance where it has been accepted or proved as a fact. The following are a few factors which might tend to substantiate any claims as to the existence of sectional accommodation:

1. Entirely possible from anatomical arrangement.

2. Measurements from contractions of other muscles show that there is a difference in tension in different fibres.

3. Probable that part of the filaments that go to the ciliary muscle may be normal while others may be partially paretic or insufficient or again, over active, thus producing irregular action on the zonula.

4. Subjectively no astigmia, 100% vision and objectively astigmia.

5. Clinical experience that correction of an objective astigmia lessens discomfort although there is no improvement in vision.

The writer has not been able to gather any data to dispute the above factors.

The words phoric and tropic are used here for want of better names. However, they will serve nicely. A phoria is a tendency towards deviation while a tropia is an actual deviation. Thus, the following are experimental results of the author, for the sake of clarity in the first person.

My prescription is plus 50 cylinder axis 90 O. U. The addition of a plus 25 sphere will blur as will also any increase in plus cylinder power. I can overcome minus spheres up to 2.50 and retain 100% vision. With any minus cylinder even as low as .50 axis 90 (opposite to my true axis) the letters become decidedly blurred but as I gaze at them they clear after a minute and then come and go. Now, here is the strange part of the experiment: I can overcome with comparative ease minus cylinders up to 2.25 axis 180. Nine other subjects produced the same comparative results.

Here is a tabulated form of the above paragraph:

1. Rx. O. U. plus 50 axis 90.

*Submitted for publication July 6, 1929.

2. Can overcome minus 2.50 sphere.
3. Minus 50 axis 90 blurs, then comes and goes.
4. Can overcome up to minus 2.25 axis 180.

How then do we account for this phenomena? The writer will not venture any solution at this time but it would seem that sectional accommodation must play some part in the experiment. Surely, there is adequate reason for research in this direction as many of our subjective tests are affected, to-wit—the use of plus or minus cylinders with the fogging test. The acuracy of the swinging axis test. The use of oblique cylinders in exercising cyclophoria and the clinical value of the test for positive and negative relative accommodation. If the experiment of the writer is of any practical value then it is possible that cylinders could be used to unlock spasm of accommodation.

DR. PHILIP DEANE,
LINCOLN, MAINE.

AMERICAN JOURNAL OF OPTOMETRY

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METHOD OF OVERCOMING THE PRISMATIC EFFECT OF ANISOMETROPIC CORRECTIONS BY BAXTER*

Should our optician or laboratory technician send us a pair of lenses so badly centered, or with uncalled for prisms of ¼ to 2 or 3 degrees or more therein, there is no doubt that most of us would promptly reject the work. Should we accept material of this nature for our patients, such careless work could very easily damage our reputations.

Most optometrists, it is true, promptly reject the optician's work, if it is a 12th degree off. Yet, strange as it may seem, nearly all of us will prescribe corrections that cannot be worn on account of prisms that were not intended, prisms at any position, base-in, out, oblique, one eye up, the other down, both up or down, or any old position a 1/12, ¼ up to 4 or 5 degrees, and expect our patients to wear such corrections!

Suppose that through the optician's poor work, or the optometrist's mistake, a base-up prism effect of a low or medium degree is produced in one eye only, and the patient attempts to use this correction with naturally unsatisfactory results. This is just exactly what we have been doing in prescribing anisometropic corrections, whenever the patient looks above or below the optic centers of the lens.

Binocular balance in anisometropia opens a field to optometry that has as yet scarcely been scratched. Anisometropia has been

*Submitted for publication July 24, 1929.

the burying ground of countless optometric failures, and according to present indications, will continue to be so. I have information from many of the best laboratories in the country that practically no refractionist pays any attention to the imbalance that invariably follows its correction.

When we consider the low ductions of the vertical muscles, and especially of those in the middle and advanced age, we are not surprised to often find that the incidental prisms that are created in anisometropic corrections on account of not looking through the optical centers of the lenses is often greater than the patient's duction. On the other hand, investigation often reveals that a surprisingly small amount of difference in the correction between the two eyes will cause an unbearable asthenopia.

The vertical ductions bear a direct relation to the amount of difference that can be borne. The ductions should be about three to four times greater than the artificial phoria.

To illustrate, consider the patient with vertical duction of 1 prism diopter whose correction calls for the right eye plus 1.00 D. Sph., the left eye plus 1.75 D. Sph. with an add of plus 2.50 D. Sph. This patient may be very uncomfortable if he happens to have a frame which holds his glasses a little high, and happens to hold his work a bit low. In this event he may look 10 to 12 m/m or more below the optical centers of his correction. Should he look 10 m below these centers, we then find that this act has set an artificial hyperphoria of ¾Δ, which is almost equal to his vertical duction.

Under any circumstances, these ductions should be increased by Kratometer or other methods. Unless we correct the artificial phoria, however, that our anisometropic correction creates, we may suffer the penalty of seeing our patient develop a very obstinate habit phoria, if he happens to follow a vocation or habit of looking below the optic centers of his lens systematically for several hours a day.

In the above correction, we correct the 0.75 D. phoria at 10m. below the optic centers by making the left segment 6m larger than the other, placing both the same height, explaining to the patient before that we will have to make one segment slightly larger than the other, on account of the difference in his eyes.

Case No. 1, Mrs. B., age 55.

Repeated subjective and objective examination called for a correction for the right eye of minus 0.50 D. Sph. Left eye minus 1.50 D. Sph. ⊃ — 1.75 D. Cyl. axis 155 add O. U. plus 2.50 D. Sph. in Kryptok bifocals. The patient could not wear the correction. Rechecking showed the formula to be correct with the assurance that she would soon be comfortable by persisting in the use of the glasses, which proved unavailing. Later study of the case revealed the super and infra ductions to be about 1.50 prism D. and that she held her close work 10 m/m below the optic centers of the uppers, which

explained the reason why she was unable to use her glasses. There are three ways to make this patient comfortable. First is to make an empiric and unscientific reduction of the left lens, with a resultant reduction of the visual acuity, and, refinements of binocular and stereoscopic visions, etc. Second is to give two pairs of glasses that are optically centered according to the position which the patient looks through each pair, or to incorporate prisms that will correct the vertical imbalance that is produced by looking the 10 m/m below the optic centers of the correction. Third is to prescribe bifocals which incorporate a vertical prism in segment, which may be done in either the cement or "ground-in" variety. The same prism effects may be produced in Kryptoks or Ultex by taking advantage of the Prentice law of decentration, by merely using different size segments. The descriptions of the plan have recently been published by J. O. Baxter, Jr., on February 7th, in the Optical Journal.

The reason our patient could not wear this correction was because of the 2¾ D. vertical prism base-down incorporated therein by looking 10 m/m below the optical centers, with only a left super duction of 1.50Δ to overcome it.

This case is not at all unusual. There is almost an infinite number of anisometropic corrections that result in both horizontal and vertical imbalances, some with much less prisms than the above case, that cannot be worn. Many of these unfortunate patients go from one doctor to the other, usually without results.

Case No. 2, Mrs. H., age 60.

Refraction O. D. — 0.75 D. Sph., O. S. + 0.75 D. Sph. add O. U. + 2.50 D. Sph. Vertical ductions 125 P. D. Patient could not read with her glasses and was very uncomfortable. Kratometer treatment gave partial relief. She was back again in a few months with the same complaint. We found that she looked 6 m/m below the optic centers, and as one eye was minus and the other plus, we found the right lens created a prism of .45 base-down and the left the same amount base-up, total artificial hyperopia .90 P. D.

By making the segment of the left eye 7 m/m larger than the right eye, we had enough base-down prism to neutralize the base-up of the left upper; also enough extra base-down in this eye to correspond with the base-down in the other eye, thereby establishing vertical balance.

Case No. 3, Mrs. W., age 65, 1918.

Vertical duction ¾ P. D. Refraction of right eye, plus 1.50 D. Sph. ⌒ + 0.25 D. Cyl. axis 165. Left eye plus 1.75 D. Sph. ⌒ + 1.00 D. Cyl. axis 15. This formula was computed from repeated examinations on several different days, yet it could not be worn. After some experimental work we found that the artificial hyperopia that we created by the difference in the correction of the two eyes practically equaled the ductions, while looking 6 to 8 m/m below centers, leaving no reserve for comfort.

In non-presbyopic cases, the optometrist may suggest that his patient should have a pair of special reading or industrial glasses made, as such work may not at times be done with ordinary distance corrections.

J. O. Baxter, Opt. D.,
New Bern, N. C.

BOOK NOTICES

OPHTHALMOSCOPY, RETINOSCOPY AND REFRACTION. By A. W. Fisher, M. D. Published by F. A. Davis Co., Philadelphia, Pa., 291 pages, 260 illustrations.

The book by Fisher on Ophthalmoscopy, Retinoscopy and Refraction covers rather well the field of ocular pathology, devoting however but little space to ocular refraction. This book is composed of 18 chapters, the greatest part of the work being devoted as has been said, to pathology. In reviewing this book, we find a really interesting chapter on slit-lamp ophthalmoscopy, with binocular microscopic observation of the cornea and lens. This chapter is of considerable value from a clinical standpoint.

There are, however, only ninety pages, which in any way refer to the subject of refraction or frame fitting. Skiametry, or as the author calls it, Retinoscopy, is given very little space, its principles being unexplained and the conclusions arrived at by the author are rudimentary. This portion of the book which is calculated to instruct the practitioner in the science and art of Optometry, is truly pathetic in its paucity.

F. McF.

SQUINT: ITS CAUSES, PATHOLOGY AND TREATMENT. By Claude Worth, F. R. C. S., Consulting Surgeon of the Royal London Ophthalmic Hosiptal (Moorfields Consulting Ophthalmic Surgeon to Queen Mary's Hospital for the East End). Sixth Edition. Cloth. Price $3.50, pp 246. Philadelphia. P. Blakistons Son and Company, 1929.

This is the sixth edition of this well known classic by Worth. In many respects the book is similar to several of the previous editions, Dr. Worth having added material however at certain points.

Worth, as we have said before, fully covers all of the older methods of treating Squint, but we regret to say completely neglects many of the newer optometric technics such as the use of the myoculator and the Kratometer, as well as the use of fusion development cards. It is to be regretted that this text has omitted much of this splendid material as for many years its author was considered the outstanding advocate for the treatment rather than the operation of Squint. Newer developments have, however, passed him by and these laurels must now go to younger men. C. C. K.

ABSTRACTS

A REPORT OF A CASE OF A PATIENT WHO WAS ONLY ABLE TO PERCEIVE MOVING OBJECTS. F. McFadden. The Commonwealth Optometrist. (Australian). Vol. X, No. 8, pp. 280-282. 1928.

McFadden presents a case of a patient, male, age 19, who applied for an automobile license. He was denied this upon the basis of being unable to read number plates on the cars ahead, being at the same time advised to have his eyes examined for suitable glasses. Upon application for an assistance of this kind, it was found by the examining optometrists, of whom McFadden was one, that he had a very slight refractive error of the hyperopic type, but of no consequence. However, they were surprised to learn that he had no macular vision whatever, having come to depend absolutely upon peripheral vision. In study he had been obliged to do his work, by an exceedingly close proximal position, being wholly dependent upon retinal magnitude of image.

Further tests of peripheral vision showed color perception satisfactory, field vision likewise, form vision correct, while of course having perfect light sense. He was able to distinguish moving objects perfectly, and likewise could tell the direction of motion of all objects in the three normal planes, which are perpendicular to each other, which is to say that he correctly perceived movement of objects moved in the horizontal in the vertical, and in the plane toward himself and away from himself.

Tests of this nature were carried out in the refraction room with the miniature lamp, and he was then taken out in a car for field study. In this test McFadden made use of small flags, one decimeter square, attached to long handles, and made of paper in white, red and green. At 500 feet distance he instantly perceived the direction in which McFadden wig-wagged any of these flags, making a like motion with his hand to indicate the direction. His perception of

the direction of movement was instantaneous. He would, likewise, correctly state the color to a companion.

The moment that motion of the flag ceased, in whatever position McFadden arrested movement of the flag, he was at a loss to tell its location in space, but the moment it again moved he instantly picked it up. His perception of moving objects was as keen and instantaneous as that of any other person whom we would class as normal, being, in fact, fully normal in respect to motion.

On riding with him as a driver, he instantly perceived people moving along the way, crossing the highway, correctly described any mobile object, however practicably small. Turning now to the factor of perceptivity of still objects, he as quickly perceived and described objects which passed across his field of view, so long as they stimulated the sensation of motion, due to our progress in the vehicle. It does not matter, claims McFadden in this type of vision, whether the object itself moves relative to a stationary eye, or the eye itself moves, the still object thereby passing successively across retinal rods, thereby successively stimulating them with light and shade, for the results are identical. T. O. B.

THE BENEFICIAL RESULTS FROM ULTRA-VIOLET RADIATION. E. Bateman. The Dioptric Bulletin, (British). Vol. XXX, No. 11, pp. 468-469. 1928.

Bateman first briefly reviews the subject of treating ocular pathology with the actinic ray. He gives two cases which were materially benefited by the use of this therapy. He then suggests that many patients who are wearing lenses made of ophthalmic glass which entirely absorbs all of the actinic ray or in other words the ultra-violet ray, suffer from hordeola. This condition is caused, he claims, because the capillaries become small and peripheral circulation sluggish, because of a lack of these ultra-violet rays. He suggests making ophthalmic lenses from Vita glass to enable the full effect of the ultra-violet to reach the eye.

C. C. K.

SCHOOL SURVEY WORK. A. M. Bennett. The Optometric Weekly. Vol. XIX, No. 30, pp. 1078-1079. 1928.

Bennett's routine for school survey work is as follows: First the monocular and binocular acuity of vision is taken and recorded; Second, an examination of the anterior surface of the cornea is made with the ophthalmometer; Third, skiametry static is employed; Fourth, a dynamic skiametric test is made with fixa-

tion at 13 inches; Fifth, a parallax muscle test is made; Sixth, an external ocular inspection is made, and last an opthalmoscopic examination concludes the survey examination. Bennett is an optometric school eye examiner in Missouri and has examined over 16,000 school children using the foregoing routine.

C. C. K.

EYES OF THE SKIES. H. S. Marshutz. The Pilot. 1929.

Visual requirements for aviators are reviewed in this paper by Marshutz. All classes of aviators must have normal form and color fields, orthophoria or nearly so and normal color perception. In addition to this the transport pilot must have an acuity of vision of 20/20 monocularly. The industrial pilot must have at least 20/30 and the private pilot at least 20/40 monocular visual acuity, uncorrected and both later groups must be equipped with corrected protection glasses when needed which bring the acuity of vision to normal monocularly. Marshutz claims the above regulations are taken from the Department of Commerce's rules for aviators.

C. C. K.

CONCOMITANT STRABISMUS AND HETEROPHORIA, THEIR CAUSES AND TREATMENTS. A. Knapp. The Commonwealth Optometrist (Australian). Vol. X, No. 7, pp. 239-241. 1928.

Knapp in a paper which largely deals with the treatment of strabismus feels that the exercising of an apparently weak muscle may be beneficial, yet he personally seems to have little faith in this type of therapy, preferring rather to relax the muscle by the prescribing of prisms in what he terms the position of rest. Five case reports are given with this paper. C. C. K.

THE RELATION BETWEEN FIELD ILLUMINATION AND THE OPTIMUM VISUAL FIELD FOR OBSERVATION INSTRUMENTS. L. C. Martin. The Optician. (British). Vol. LXXVI, No. 1928, pp. 232-233. 1928.

The paper describes some experiments based on the application of the results of recent studies on "spacial induction" in vision to determine the conditions governing the optimum size of visual field under certain conditions. The results have a bearing on recent efforts to enlarge the fields of view of binoculars, indicating also that small fields are better under certain conditions.

As the general physiological and psychological conditions of an

observer are not under precise control at any time, and as these factors influence retinal sensitiveness, a statistical method of experiment was employed.

The eye observed the objects by means of a telescope, the direction of vision being fixed towards a small central aperture seen in the illuminated field. After a definite period of this fixity of vision, a test object of *such brightness that it was only distinguishable with difficulty*, was exposed momentarily at this central aperture. After a definite interval another object was exposed which had to be recognized if possible; the observer recorded the appearances of a number of these exposures. The size only of the surrounding field was then changed and the observations systematically repeated, the grouping of the observations being so chosen to eliminate in the final result, as far as possible, the "education" and "fatigue" effects which are always to be encountered in experiments of such a character.

By checking the observer's record with the actual series of objects exposed, the comparative accuracy when using a large field and a small field could be estimated from the number of errors and missed observations.

It has been shown that under certain conditions of vision with a telescope, when relatively dark objects must be observed in the center of a bright field, advantage can be obtained by reducing the size or brightness of the peripheral parts of the visual image. The advantage indicated by laboratory experiments of a statistical kind has been confirmed by quantitative field tests with binoculars possessing a variable field. On the other hand the experiments have clearly confirmed the advantage of a large field under conditions of low illumination or where the object is brighter than the surrounding field.

These results are in harmony with those expected from previous experiments on visual sensitiveness. It is not intended to discuss the physiological aspects of the results at present, but it may be pointed out that these experiments have again tended (so far as they go) to confirm the results of Emerson and Martin, who found the shorter wavelengths to be more effective (for equal visual luminosity) in their effects of induction. If the peripheral parts of the field were dimmed by means of an annular yellow filter it would be probably as effective as an actual reduction in the size of the field, but the latter expedient, while interesting, will probably not commend itself to instrument makers who may, however, feel inclined to make some experiments for themselves on binoculars with variable fields.

T. O. B.

SYSTEMS OF EXAMINATION. J. Bailey. The Optician. (British). Vol. LXXVI, No. 1928, pp. 227-228. 1928.

Bailey claims that many routine refractions contain too many

non-essential features and advocates cutting the refractive procedure to the following, feeling that by the use of these tests everything of need will be accomplished. (a) External examination of the eye by means of focal illumination. (b) Ophthalmoscopic examination. (c) Skiametric test. (d) Subjective examination. (e) Charting the field of vision and finally (g) the phoria and duction tests.

T.O.B.

THE DOMINANT EYE. C. E. Bateman. The Refractionist (British). Vol. 17, No. 253, pp. 374-375. 1928.

Bateman concludes that every patient has a dominant eye, but believes that in 95 per cent of the cases the dominant eye is the result of refractive errors, though he admits that psychological factors may enter into this. T. O. B.

STATEMENT OF OWNERSHIP

Management and Circulation as required by the Act of Congress of August 24th, 1912, of the American Journal of Optometry, published monthly at Minneapolis, Minnesota, for October 1st, 1928.

State of Minnesota, County of Hennepin—ss.

Before me, a Notary Public in and for the State and County aforesaid, personally appeared Dr. Jack I. Kurtz, who having been duly sworn according to law, deposes and says that he is the Business Manager of the American Journal of Optometry and that the following is to the best of his knowledge and belief, a true statement of the ownership and management of the aforesaid publication for the date shown in the above caption required by the Act of August 24th, 1912, embodied in Section 411, Postal Laws and Regulations, to-wit:

First, that the names and addresses of the Publisher, Editor, and Business Manager are as follows: Publisher, The American Journal of Optometry Publishing Association, 209 Yeates Building, Minneapolis, Minnesota. Editor, Dr. Carel C. Koch, 209 Yeates, Minneapolis, Minnesota. Business Manager, Dr. Jack I. Kurtz, 209 Yeates Building, Minneapolis, Minnesota.

Second, that the owner is the American Journal of Optometry Publishing Association—Dr. Carel C. Koch, President, and Dr. Jack I. Kurtz, Secretary and Treasurer.

Third, that there are no bondholders, mortgagees, or other security holders owning or holding one or more per cent of the total amount of bonds, mortgages or other securities of this publication.

DR. JACK I. KURTZ, Business Manager,
The American Journal of Optometry.

Sworn and subscribed before me this 30th day of September, 1929.

MARGARET WILLIAMSON, Notary Public,
Hennepin County, Minnesota.

(My commission expires Jan. 14, 1933.)

ANNOTATIONS AND SOCIETY PROCEEDINGS

The American Journal of Optometry is the Official Organ of the American Academy of Optometry, as well as the Organ of the Arkansas, Delaware, Indiana, Iowa, Maine, Maryland, Michigan, Minnesota, Nebraska, North Dakota, Oklahoma, Pennsylvania, South Dakota, Vermont and West Virginia Optometric Associations.

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PENNSYLVANIA STATE COLLEGE OF OPTOMETRY

The course of instruction at the Pennsylvania State College of Optometry extends over a period of three years, with one session in each year, beginning in September and ending in June.

The course may be said to be divided into two distinct periods: The first period of two years devoted to the study of Optometry and the fundamental optometrical sciences, *i. e.*, Physics, Geometrical and Physiological Optics, Mathematics, Anatomy, Physiology, Histology, Chemistry, and Pathology, and the second period of one year to the application in clinical practice of the subjects studied in the first period.

In the first two years, instruction is given both in the classroom and in the laboratory. An effort is made to give the student, through practical laboratory work, a workable knowledge of the various subjects, and to present those subjects in their logical sequence so as to fix them more firmly in his mind.

Especial attention is given in the first year to Anatomy, Chemistry, Physiology, Mathematics and Physics, as a good foundation in these fundamental sciences is a requisite for the higher studies of the second year. Elementary Physical Geometrical Optics are included in the course in Physics.

An elementary course in optometric procedure is also given during the first year so that the student may become familiar with the various instruments and apparatus used in ocular examinations and

this is supplemented by an optometric clinic held once a week throughout the year.

In the second year, there begins an intensive study of physical geometrical and physiological optics, optometrical instrumentation, and clinical procedure. In addition, the student is given a course in physiological chemistry which is followed by a semester of intensive clinical practice.

The diagnosis and treatment of ocular pathology are discussed exhaustively in this and the following year, for, while the principal work of the student will be the correction of refractive and muscular abnormalities, it is equally important that he be able to recognize these diseased conditions so that he may render a more complete service to his patient.

By frequent attendance in the clinic the second year student is prepared for the practical work of the third year. In the third year, the work consists mainly of instruction in the clinical subjects, refraction, muscular anomalies, and ocular pathology, which is given almost entirely in the College clinics.

The clinical equipment and facilities have been augmented from time to time until at present the College has what is probably the most complete plant in existence devoted to optometrical work. Thus the facilities for instruction of all types are abundant and it is possible to offer to each student opportunities to come into personal and frequent contact under proper supervision with a large number of cases.

The policy of this institution is to offer the student a well articulated comprehensive course which will fit him to practice Optometry, rather than a specialized course in optical engineering. Our constant aim is to make practical and intelligent practitioners of the under-graduates.

An outline of the course is given below:

FIRST YEAR

Physiologic Optics, Ocular Symptomatology and Diagnosis, Optometrical Clinic, Gross Anatomy, Histology and Embryology, Ocular Anatomy, General Physiology, Physiological Laboratory, General Pathology, Advanced Algebra, Trigonometry, General Physics, Laboratory Physics, Organic Chemistry, Ophthalmic Lens Surfacing and Edging.

SECOND YEAR

Physiological Optics, Optometrical Practice and Jurisprudence, Clinical Conferences, Clinical Optometry, Ocular Physiology, Ophthalmic Pathology, Clinical Ophthalmic Pathology, Analytrical Goemetry and Calculus, Physical and Geometrical Optics, Laboratory, Physiological Chemistry, Physiological Chemistry Laboratory, General and Visual Psychology, Ophthalmic Lens Mounting and Adjusting.

THIRD YEAR

Physiological Optics, Optometrical Practice, Clinical Conferences, Clinical Optometry, Ophthalmic Pathology and Hygiene, Physical and Geometrical Optics, Frame Fitting and Adjusting.

It will be noted in the third year that the principal attention

is given to actual practice in the clinic. Here the student is registered as a clinical assistant and spends most of his time in the clinic working upon the patient. These public clinics are held in the Clinical Annex and are very largely attended. The service rendered to the needy poor of the city includes the providing of glasses in such cases where they are necessary, but where the patient is unable to pay for them. Other cases are given prescriptions for glasses, treatment, or advice, as may be required. An important function of the clinic is to provide a means of obtaining competent consultation for practicing Optometrists in different cases, and certain periods each week are set aside for exclusive attention to such cases.

The equipment for this work includes all modern instruments and appliances, which are contained in twelve individual refracting rooms, an ophthalmological treatment room, a fitting room, a clinical amphitheatre, and adequate office and waiting space.

Examinations are made by the senior students, under the direction of experienced and skilled practitioners. The clinical organization is under the supervision of a director and a chief or clinics, who are assisted by a number of associates who overlook and direct the examination work of the students.

This institution by virtue of the special action of the Legislature and Governor of Pennsylvania, has received the power to confer the degree of Doctor of Optometry upon candidates who comply with all the requirements for admission to, and graduation from, the three-year course. The Doctorate Degree as conferred by this institution is therefore fully equivalent to that bestowed by any other professional school. The minimum amount of work required of candidates for the degree of Doctor of Optometry is the satisfactory completion of the subjects of the course, all of which are prescribed. This course, as already outlined, is designed to fit the graduate to practice intelligently and successfully. Requirements for the license to practice Optometry differ in the various states. The State of Pennsylvania imposes a higher professional requirement than any other state, as the Pennsylvania Optometry Law requires three years of professional college work for admission to examination in that state. Work completed as part of a college course in Arts and Sciences is not acceptable as complying with these regulations, nor is any course which includes the so-called cultural subjects, such as foreign languages, history, philosophy, etc., considered as complying with the professional requirements. All subjects offered in the course in this institution are professional in character and have a direct bearing upon the future practice of the student.

* * * * * *

CALIFORNIA RESEARCH GROUP

Dr. A. R. Reinke, Secretary of the California Research Group in the Science of Vision, announces that their regular monthly meeting was held at the Bellevue Hotel, San Francisco, Friday, September 13th. The following papers were presented: "Variable Factors Influencing the Breadth of the Color Field," by Dr. V. C. Lynn; "The Hypersusceptibility to Caffeine," by Dr. Harry Camphoefner; "The Study of the Pathway Through Which Alkaloid Toxemia May Act in Order to Effect Fields," by Dr. H. G. Marquez; "Television," by Professor Ralph Minor.

* * * * * *

GRADUATE CLINIC FOUNDATION

Dr. A. M. Skeffington, national clinician for the Graduate Clinic Foundation has started working on a 1929-1930 group of study classes. Dr. Skeffington just returned from Vienna, where he spent several interesting months doing research work in the clinics of that city. Dr. Skeffington announces that study courses have been planned for 42 cities during the coming season and urges all practitioners interested to get in touch with their local chairman at once.

* * * * * *

MICHIGAN SOCIETY OF OPTOMETRISTS

The Thirty-third Annual Convention of the Michigan Society of Optometrists will be held at the Durant Hotel, Flint, Michigan, on October 8th, 9th and 10th. Dr. George Younmans is chairman of the General Arrangements Committee for the three-day session during which time a number of talks will be held.

* * * * * *

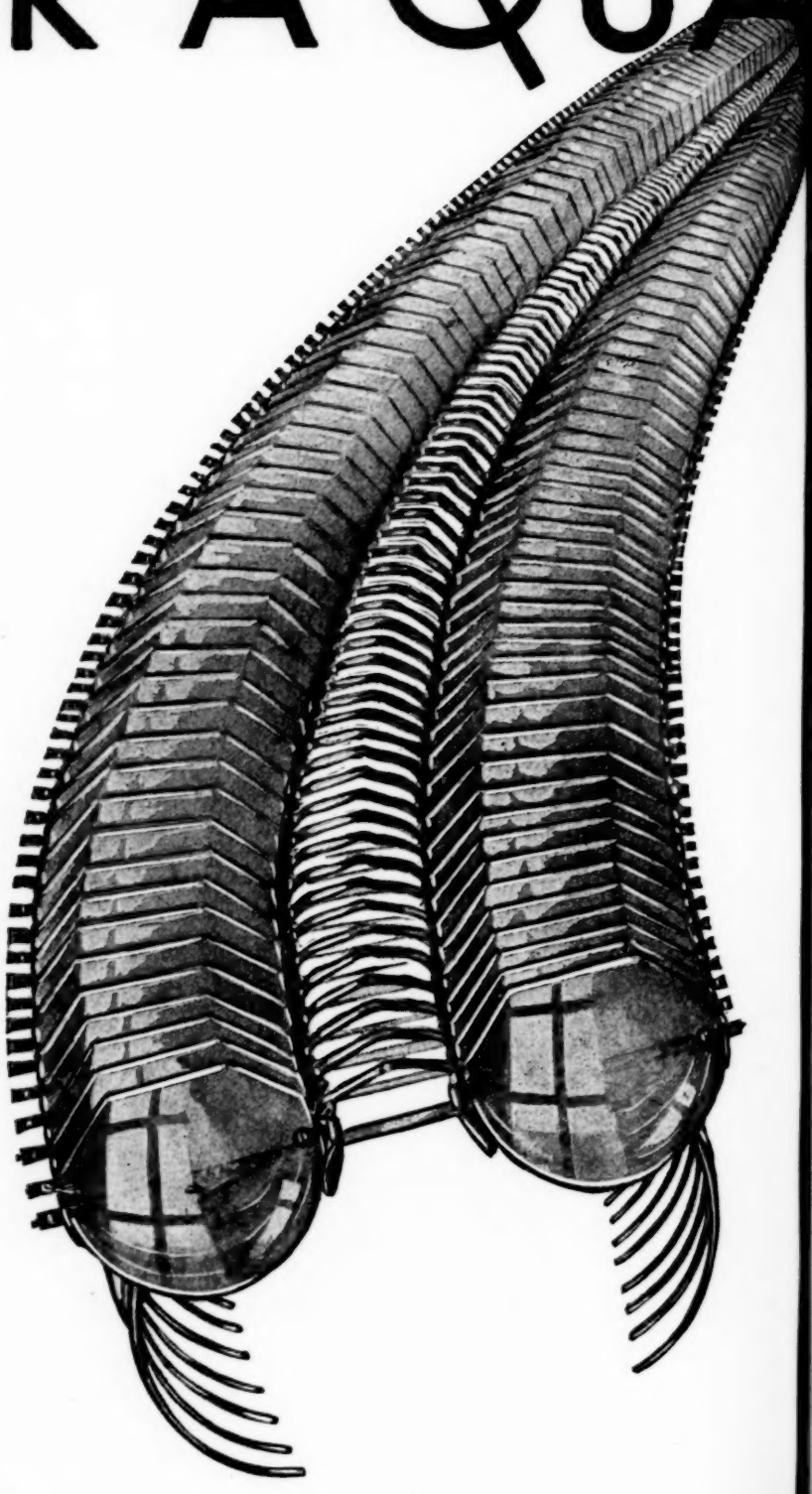
LECTURE ON OCULAR PHYSIOTHERAPY

Dr. J. I. Kurtz, Optometrist of Minneapolis, will deliver a series of lectures in several of the New England states during the last part of the month of December of this year on the principles and application of Ocular Physiotherapy. In his lectures Dr. Kurtz will cover some of the following subjects:

(1) Physical therapy, a natural part of the practice of Optometry; (2) Electrical energy and its relation to the human body; (3) The nature of therapeutic electrical currents; (4) The effects of physical therapy on the ocular muscles and nerves; (5) Treatment of amblyopia and pseudo myopia; (6) The relief of ocular pain; (7) Technic for the ocular application of physical therapy; (8) Clinical demonstrations of the use of physical therapy instruments; (9) The prevention of the development of ocular pathology through the use of physical therapy; (10) The control and treatment of cataract with Physiotherapy; (11) The general management of difficult cases.

There will only be five study groups, organized throughout the New England states. One day of lectures and demonstrations will be given to each group, classes will be limited in size. Further particulars regarding the time, place, etc., may be had by writing to Dr. J. I. Kurtz, American Journal of Optometry, Yeates Building, Minneapolis, Minnesota.

OVER A QUA



The engraved Clingswell may now be had with delicately engraved ends.

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